REMARKS

Claims 1 through 3, 6, 7, 16, and 17 have been canceled. Claims 4, 8 through 11, and 14 have been amended. Claims 4, 5, 8 through 15, and 18 through 20 remain in the application.

Claims 1 through 3 were rejected under 35 U.S.C. § 112, second paragraph, as being indefinite. Applicants have canceled claims 1 through 3 and the rejection as to these claims is now moot.

Claims 1 and 2 were rejected under 35 U.S.C. § 102(b) as being anticipated by Chen et al. ("Computer-Aided Engineering", Ford Research Laboratory Technical Report #AJ449, (1999)). Applicants have canceled claims 1 and 2 and the rejection as to these claims is now moot.

Claims 3, 4, 6 through 14, and 16 through 20 were rejected under 35 U.S.C. § 103 as being unpatentable over Chen et al. in view of Stewart et al. (U.S. Patent No. 5,731,816). Applicants respectfully traverse this rejection.

"Computer-Aided Engineering", Ford Research Laboratory Technical Report #AJ449, (1999) to Chen et al. discloses computer-aided engineering (CAE) technologies an unprecedented role in the Ford Product Development System (FPDS). CAE simulations allow verification of design intent and prediction of a wide range of mechanical behaviors of a vehicle, its systems, and components. A new Interactive Mesh Feature, or IMF, software tool was developed by the ICDA project in the CAE department of FRL. Utilizing a modified version of an advance surface feature tool, called Direct Surface Manipulation (DSM), the first release of this mesh modeling tool allows the designer to directly modify a CAE model by adding features to the existing mesh. A DSM menu is for mesh feature editing. Chen et al. does <u>not</u> disclose modifying a surface of the mesh model by varying a predetermined parameter, wherein the

surface is modified using direct surface manipulation (DSM) by defining a sketch plane containing a domain of a DSM feature, positioning the sketch plane relative to the surface of the model, locating a reference center within the domain, projecting a vertex located on the surface of the mesh model into the domain of the sketch plane, specifying a maximum displacement of the DSM feature by locating a reference vector centered at the reference center to define the height of the DSM feature in object space, specifying a basis function to determine a displacement of the vertex, determining a displacement of the vertex relative to the DSM feature using the basis function, and using the displacement of the vertex to modify the surface of the mesh model.

U.S. Patent No. 5,731,816 to Stewart et al. discloses a system and method for direct modeling of fillets and draft angles. FIG. 2 provides a brief overview of a prior art process for creating surface features with fillets. Beginning with a base surface 50 and a surface feature 52, the designer creates a number of fillet segments 54 separated by individual piecewise fillet profiles 56 which extend between a fillet outer boundary 58 on the base surface 50, and a fillet inner boundary 60 on the surface feature 52. The inner boundary defines a portion of the feature and the outer boundary defines the entire feature on the base surface. The location and characteristics of each fillet profile 56 extending between the outer boundary 58 and the inner boundary 60 are largely dependent upon the experience of the designer and selective use of trial-and-error to produce an acceptable part. If the surface feature is subsequently relocated, or a test run indicates difficulty in manufacturing acceptable parts, one or more of the fillet segments 54 and profiles 56 must be recreated. Stewart et al. does <u>not</u> disclose modifying a surface of the mesh model by varying a predetermined parameter, wherein the surface is modified using direct surface manipulation (DSM) by defining a sketch plane containing a domain of a DSM feature, positioning the sketch plane relative to the surface of the model, locating a reference center within the domain, projecting a vertex located on the surface of the mesh model into the domain

of the sketch plane, specifying a maximum displacement of the DSM feature by locating a reference vector centered at the reference center to define the height of the DSM feature in object space, specifying a basis function to determine a displacement of the vertex, determining a displacement of the vertex relative to the DSM feature using the basis function, and using the displacement of the vertex to modify the surface of the mesh model.

In contradistinction, claim 4, as amended, clarifies the invention claimed as a method for design of experiments using direct surface manipulation of a mesh model. The method includes the steps of selecting a geometric model, wherein the model is in a computer-aided design (CAD) format and converting the geometric model into a mesh model. The method also includes the steps of evaluating the mesh model using a computer-aided engineering (CAE) analysis and determining whether to continue generating the design of experiments response. The method includes the steps of modifying a surface of the mesh model by varying a predetermined parameter, wherein the surface is modified using direct surface manipulation (DSM) by defining a sketch plane containing a domain of a DSM feature, positioning the sketch plane relative to the surface of the model, locating a reference center within the domain, projecting a vertex located on the surface of the mesh model into the domain of the sketch plane, specifying a maximum displacement of the DSM feature by locating a reference vector centered at the reference center to define the height of the DSM feature in object space, specifying a basis function to determine a displacement of the vertex, determining a displacement of the vertex relative to the DSM feature using the basis function, and using the displacement of the vertex to modify the surface of the mesh model. The mesh model is updated and the updated mesh model is used in continuing generating the design of experiments response, if determined to continue generating the design of experiments response. The method further includes the steps of using

the results of the CAE analysis for the design of experiments. Claim 14 has been amended similar to claim 4 and includes other features of the present invention.

The United States Court of Appeals for the Federal Circuit (CAFC) has stated in determining the propriety of a rejection under 35 U.S.C. § 103, it is well settled that the obviousness of an invention cannot be established by combining the teachings of the prior art absent some teaching, suggestion or incentive supporting the combination. See In re Fine, 837 F.2d 1071, 5 U.S.P.Q.2d 1596 (Fed. Cir. 1988); Ashland Oil, Inc. v. Delta Resins & Refractories, Inc., 776 F.2d 281, 227 U.S.P.Q. 657 (Fed. Cir. 1985); ACS Hospital Systems, Inc. v. Montefiore Hospital, 732 F.2d 1572, 221 U.S.P.Q. 929 (Fed. Cir. 1984). The law followed by our court of review and the Board of Patent Appeals and Interferences is that "[a] prima facie case of obviousness is established when the teachings from the prior art itself would appear to have suggested the claimed subject matter to a person of ordinary skill in the art." In re Rinehart, 531 F.2d 1048, 1051, 189 U.S.P.Q. 143, 147 (C.C.P.A. 1976). See also In re Lalu, 747 F.2d 703, 705, 223 U.S.P.Q. 1257, 1258 (Fed. Cir. 1984) ("In determining whether a case of prima facie obviousness exists, it is necessary to ascertain whether the prior art teachings would appear to be sufficient to one of ordinary skill in the art to suggest making the claimed substitution or other modification.")

None of the references cited, either alone or in combination with each other, teaches or suggests the claimed invention of claims 4 and 14. Chen et al. merely discloses computer-aided engineering (CAE) technologies in which an advance surface feature tool, called Direct Surface Manipulation (DSM), allows a designer to directly modify a CAE model by adding features to the existing mesh. Chen et al. lacks modifying a surface of the mesh model by varying a predetermined parameter, wherein the surface is modified using direct surface manipulation (DSM) by defining a sketch plane containing a domain of a DSM feature,

positioning the sketch plane relative to the surface of the model, locating a reference center within the domain, projecting a vertex located on the surface of the mesh model into the domain of the sketch plane, specifying a maximum displacement of the DSM feature by locating a reference vector centered at the reference center to define the height of the DSM feature in object space, specifying a basis function to determine a displacement of the vertex, determining a displacement of the vertex relative to the DSM feature using the basis function, and using the displacement of the vertex to modify the surface of the mesh model. In Chen et al., the DSM menu allows creation of a mesh feature using DSM, but does <u>not</u> use direct surface manipulation (DSM) by defining a sketch plane containing a domain of a DSM feature, positioning the sketch plane relative to the surface of the model, locating a reference center within the domain, projecting a vertex located on a surface of a mesh model into the domain of the sketch plane, specifying a maximum displacement of the DSM feature by locating a reference vector centered at the reference center to define the height of the DSM feature in object space, specifying a basis function to determine a displacement of the vertex, determining a displacement of the vertex relative to the DSM feature using the basis function, and using the displacement of the vertex to modify the surface of the mesh model.

Stewart et al. '816 <u>merely</u> discloses a system and method for direct modeling of fillets and draft angles in which location and characteristics of each fillet profile extending between outer boundary and inner boundary are largely dependent upon the experience of the designer and selective use of trial-and-error to produce an acceptable part and if the surface feature is subsequently relocated, or a test run indicates difficulty in manufacturing acceptable parts, one or more of the fillet segments and profiles must be recreated. Stewart et al. '816 lacks modifying a surface of the mesh model by varying a predetermined parameter, wherein the surface is modified using direct surface manipulation (DSM) by defining a sketch plane

containing a domain of a DSM feature, positioning the sketch plane relative to the surface of the model, locating a reference center within the domain, projecting a vertex located on the surface of the mesh model into the domain of the sketch plane, specifying a maximum displacement of the DSM feature by locating a reference vector centered at the reference center to define the height of the DSM feature in object space, specifying a basis function to determine a displacement of the vertex, determining a displacement of the vertex relative to the DSM feature using the basis function, and using the displacement of the vertex to modify the surface of the mesh model. In Stewart et al. '816, the designer creates a number of fillet segments 54 separated by individual piecewise fillet profiles 56 which extend between a fillet outer boundary 58 on the base surface 50, and a fillet inner boundary 60 on the surface feature 52, but does <u>not</u> use direct surface manipulation (DSM) by defining a sketch plane containing a domain of a DSM feature, positioning the sketch plane relative to the surface of the model, locating a reference center within the domain, projecting a vertex located on a surface of a mesh model into the domain of the sketch plane, specifying a maximum displacement of the DSM feature by locating a reference vector centered at the reference center to define the height of the DSM feature in object space, specifying a basis function to determine a displacement of the vertex, determining a displacement of the vertex relative to the DSM feature using the basis function, and using the displacement of the vertex to modify the surface of the mesh model. As such, there is no suggestion or motivation in the art to combine Chen et al. and Stewart et al. '816 together.

The present invention sets forth a unique and non-obvious combination of a method for design of experiments using direct surface manipulation of a mesh model in which a mesh model is updated using Direct Surface Manipulation after a DOE parameter is varied, instead of updating the CAD model and converting the updated CAD model to a mesh model. The reference, if modifiable, fails to teach or suggest the combination of a method for design of

experiments using direct surface manipulation of a mesh model including the steps of selecting a geometric model, wherein the model is in a computer-aided design (CAD) format and converting the geometric model into a mesh model, evaluating the mesh model using a computer-aided engineering (CAE) analysis, determining whether to continue generating the design of experiments response, modifying a surface of the mesh model by varying a predetermined parameter, wherein the surface is modified using direct surface manipulation (DSM) by defining a sketch plane containing a domain of a DSM feature, positioning the sketch plane relative to the surface of the model, locating a reference center within the domain, projecting a vertex located on the surface of the mesh model into the domain of the sketch plane, specifying a maximum displacement of the DSM feature by locating a reference vector centered at the reference center to define the height of the DSM feature in object space, specifying a basis function to determine a displacement of the vertex, determining a displacement of the vertex relative to the DSM feature using the basis function, and using the displacement of the vertex to modify the surface of the mesh model, the mesh model is updated and the updated mesh model is used in continuing generating the design of experiments response, if determined to continue generating the design of experiments response, and using the results of the CAE analysis for the design of experiments as claimed by Applicants.

Further, the CAFC has held that "[t]he mere fact that prior art could be so modified would not have made the modification obvious unless the prior art suggested the desirability of the modification". In re Gordon, 733 F.2d 900, 902, 221 U.S.P.Q. 1125, 1127 (Fed. Cir. 1984). The Examiner has failed to show how the prior art suggested the desirability of modification to achieve Applicants' invention. Thus, the Examiner has failed to establish a case of prima facie obviousness. Therefore, it is respectfully submitted that claims 4 and 14 and the claims dependent therefrom are allowable over the rejection under 35 U.S.C. § 103.

Claims 5 and 15 were rejected under 35 U.S.C. § 103 as being unpatentable over Chen et al. and Stewart et al. '816 and further in view of Dehmlow et al. (U.S. Patent No. 5,999,187). Applicants respectfully traverse this rejection for the same reasons given above to claims 4 and 14.

Obviousness under § 103 is a legal conclusion based on factual evidence (In re Fine, 837 F.2d 1071, 1073, 5 U.S.P.Q.2d 1596, 1598 (Fed. Cir. 1988), and the subjective opinion of the Examiner as to what is or is not obvious, without evidence in support thereof, does not suffice. Since the Examiner has not provided a sufficient factual basis, which is supportive of his/her position (see In re Warner, 379 F.2d 1011, 1017, 154 U.S.P.Q. 173, 178 (C.C.P.A. 1967), cert. denied, 389 U.S. 1057 (1968)), the rejections of claims 4, 5, 8 through 15, and 18 through 20 are improper. Therefore, it is respectfully submitted that claims 4, 5, 8 through 15, and 18 through 20 are allowable over the rejections under 35 U.S.C. § 103.

Based on the above, it is respectfully submitted that the claims are in a condition for allowance, which allowance is solicited.

Respectfully submitted,

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